

**HABITAT ASSESSMENT FOR THE
COLORADO LAGOON RESTORATION
FEASIBILITY STUDY FOR THE
CITY OF LONG BEACH**

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I. EXECUTIVE SUMMARY

Chambers Group, Inc., was retained to conduct a biological survey of Colorado Lagoon in Long Beach, California. The purpose of this report is to describe the existing biological resources and habitat quality as it occurs at Colorado Lagoon, and to identify potential opportunities to improve the native habitat. The City of Long Beach is developing a plan to improve water quality and restore habitat in Colorado Lagoon. A summary of the survey results appears below.

A field survey of marine resources was conducted on July 1, 2004. Survey methods included underwater reconnaissance, sediment sampling for invertebrates from coring, fish sampling from seine nets, and terrestrial habitat mapping.

Colorado Lagoon has a narrow bank that slopes steeply to a mud bottom with a depth of about 12 Mean Lower Low Water (MLLW). The substrate throughout most of the lagoon is soft bottom. The pier that spans the center of the lagoon as well as the dock northwest of it provide hard surface for the attachment of sessile organisms. Three plant communities, as well as bare sand and open water, were identified and mapped during the survey. The plant communities in the project area included coastal brackish marsh, iceplant series, and ornamental landscaping.

The water quality data indicate that Colorado Lagoon does not experience extreme temperature or salinity levels, but that dissolved oxygen levels are low during the summer. Nutrient levels are elevated at times. A heavy cover of benthic algae was observed over the bottom. In the northeastern part of the lagoon the dominant algae were primarily *Eneteromorpha intestinalis* and *Ulva lobata*. In the western part of the lagoon, a species of red algae, *Gracilaria* sp., was the dominant bottom vegetation. A few scattered eelgrass plants were observed.

The most abundant epifaunal invertebrate observed on the bottom during the July 1 reconnaissance dive was the gelatinous colonial bryozoan *Zoobotryon verticillatum*. The solitary tunicate *Styela plicata* also was common on the bottom of the lagoon and on the pier pilings. Other invertebrates observed during the survey included the introduced mussel *Musculista senhousi* and the bubble snail *Bulla gouldiana*. The California horn snail *Cerithidea californica* was very abundant along the intertidal edges of the lagoon. Four species of clam were collected along the shores of Colorado Lagoon during the July 6 clam survey. The clam species collected included smooth chione (*Chione fluctifraga*), common littleneck (*Protothaca staminea*), California jackknife clam (*Tagelus californianus*), and Phillipine cockle (*Venerupis philipinarum*).

Colorado Lagoon supports a relatively diverse benthic invertebrate community in the central and northeast portions of the lagoon. The benthic invertebrate community is impoverished in the western arm. The lack of invertebrate diversity in the western arm may be related to toxicity in the sediments or to the relatively low dissolved oxygen levels in this part of the lagoon.

A total of 13 species of fish were caught in the three seine hauls. All are typical estuarine/bay species. Approximately the same number of fish species was caught at each station. A total of 9 species were caught in the central and eastern portions of the lagoon and 8 species were caught in the west end. The most abundant fish species collected at each of the stations was topsmelt (*Atherinops affinis*), followed by arrow goby (*Clevelandia ios*) and California killifish (*Fundulus parvipinnis*). A large number of round stingrays (*Urolophus halleri*) were collected at the station in the west arm. All of the individuals caught were females and many were gravid.

A comparison of the 1973 study with the July 2004 survey suggests that, in general, the fish community in Colorado Lagoon in 2004 is similar to that in 1973.

Many waterbirds use Colorado Lagoon for resting and foraging. Bird use of the lagoon peaks in the winter months with as many as 600 species visiting the lagoon in February (Bentley-Smith 2003). Fewer birds frequent the lagoon in the summer months.

Colorado Lagoon is located in the middle of suburban Long Beach. Therefore, terrestrial wildlife associated with the lagoon is dominated by urban-adapted species. Land bird species observed by Chambers Group during visits to Colorado Lagoon included black phoebe (*Sayornis nigricans*), American crow (*Corvus brachyrhynchos*), cliff swallow (*Hirundo pyrrhonota*), and rock dove (*Columba livia*). A number of urban-adapted mammal species have been observed around Colorado Lagoon. These include striped skunk (*Mephitis mephitis*), opossum (*Didelphis marsupialis*), ground squirrels (*Citellus beecheyi*), red fox (*Vulpes fulva*), raccoon (*Procyon lotor*), and a coyote (*Canis latrans*).

Several habitat enhancement opportunities exist for Colorado Lagoon. The degraded marsh could be enhanced by increasing the width of the intertidal area, removing invasive ice plant, and protecting the habitat from human intrusion.

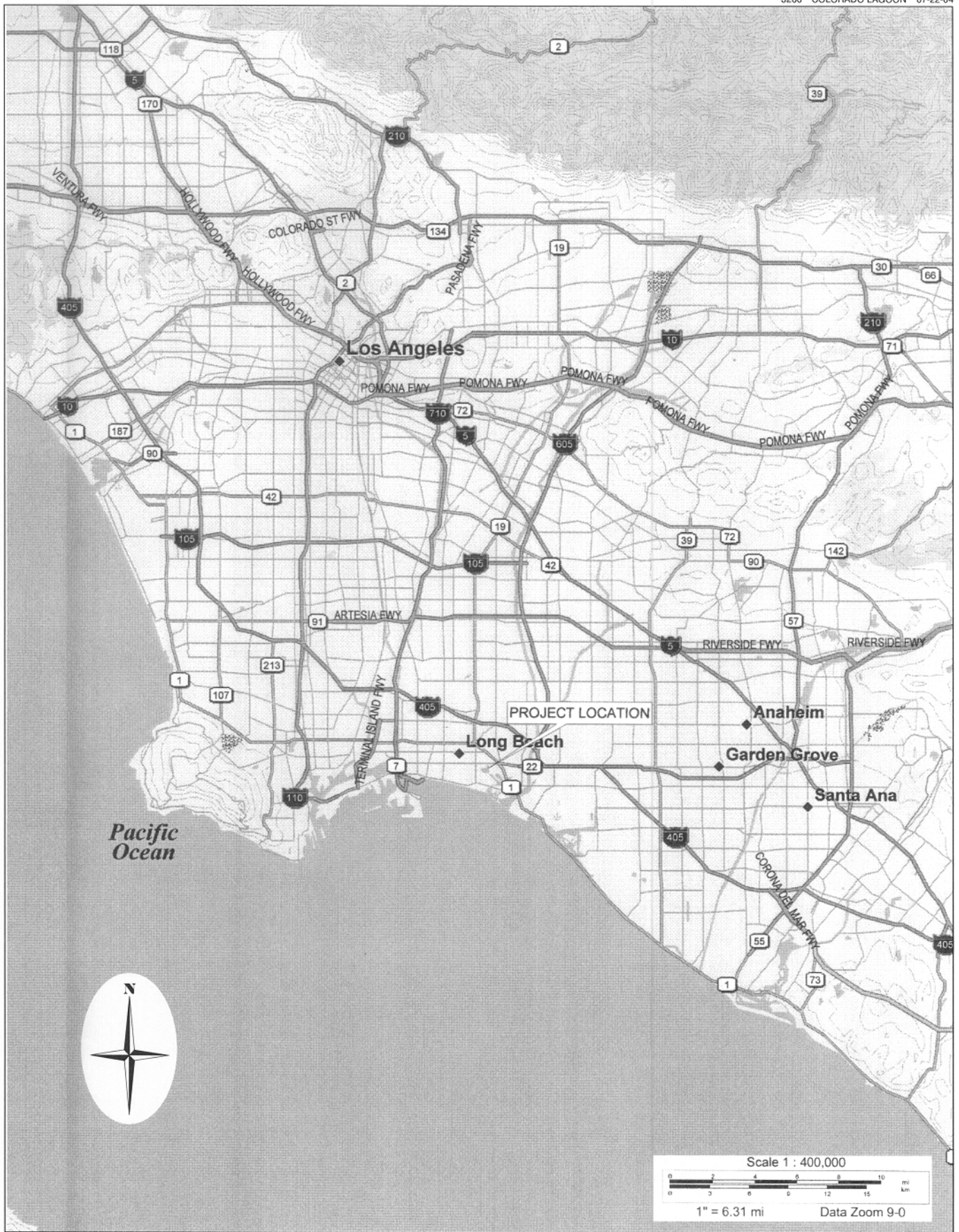
SECTION 1.0 – INTRODUCTION

Colorado Lagoon is a tidally influenced, Y-shaped body of water forming the uppermost, northwestern portion of Alamitos Bay. Figure 1 shows the location of Colorado Lagoon. Colorado Lagoon is connected to Marine Stadium and the rest of Alamitos Bay by tide gates and an underground waterway. These restrictions to water movement mute the tides so that the tidal range in Colorado Lagoon is less than that of Marine Stadium.

Colorado Lagoon forms the centerpiece of a recreational area that supports a variety of public uses including, swimming, picnicking, fishing, bird watching, and dog walking. Although it is developed as a recreational area with landscaping and imported sand, the edges of the lagoon support saltmarsh habitat and the lagoon waters provide habitat for estuarine fishes and invertebrates as well as a variety of water-associated birds.

Colorado Lagoon is at a natural low point in an approximately 1,172-acre watershed comprised primarily of suburban residential development with a small amount of commercial and institutional land use. The lagoon receives drainage from this watershed via five reinforced concrete pipes that discharge storm run-off and dry weather flows into the lagoon. Pollutants deposited over the watershed accumulate in the lagoon. Colorado Lagoon is listed on the California Section 303(d) list of impaired water bodies as impaired for lead, zinc, sediment toxicity, chlordane, DDT, dieldrin, PAHs, and PCBs (RWQCB 2002).

The City of Long Beach is developing a plan to improve water quality and restore habitat in Colorado Lagoon. The purpose of this habitat assessment is to describe the existing biological resources and habitat quality of the lagoon and to identify the potential for habitat improvement. A companion report specifically describes sensitive species issues in Colorado Lagoon.



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PROJECT LOCATION MAP
COLORADO LAGOON
Figure 1

SECTION 2.0 – METHODS

This habitat assessment is based on a literature review of information on Colorado Lagoon, contacts with persons knowledgeable about the biological resources of Colorado Lagoon, and a field survey of the lagoon. Relevant literature that was used in developing this habitat assessment is referenced in Section 6.0 of this report. Persons contacted about Colorado Lagoon biology are listed in Section 7. In addition, information on Colorado Lagoon water column parameters was obtained from the Surfrider Foundation website.

2.1 AQUATIC HABITAT

A field survey of marine resources in Colorado Lagoon was performed on July 1, 2004 by Dr. Noel Davis, Todd Chapman, Shelby Howard, and Ken McDonald of Chambers Group. The survey took place between 0700 and 1600. Table 1 shows tides at Los Angeles Harbor on July 1. It should be noted that these tide times and levels do not represent the tides in the Colorado Lagoon, as there is a tidal time lag and the low tide elevation is muted in the lagoon.

Table 1
Tides at Los Angeles Outer Harbor on July 1, 2004

Time of Tide	Elevation (Feet MLLW)
0332	- 1.5
1008	+3.9
1430	+2.2
2053	+7.2

Dr. Davis performed an underwater reconnaissance survey of the lagoon. She also took sediment samples for the purpose of identifying infaunal invertebrates in the lagoon. Three sets of three replicate core samples were taken with a hand held coring device. One sample set was taken in the west arm of the lagoon, one set was taken in the central portion of the lagoon and the third set was taken in the north arm. Figure 2 shows the location of the core samples. The coring device was 10 centimeters in diameter and 10 centimeters deep. Core samples were processed in the field by screening the samples with seawater through a sieve with 1 millimeter mesh. Materials retained on the screen were fixed with a buffered formalin solution and taken to the laboratory where they were transferred to an alcohol/glycerin mixture. In the laboratory, organisms were sorted from the debris under a dissecting microscope. Invertebrates were identified to the lowest possible taxon by Tom Gerlinger.

Estuarine fishes were sampled with a 100-foot long beach seine. The seine was set parallel to the beach and pulled to shore. All of the fishes collected in the net were identified to species and counted. The standard length of up to 100 individuals of each species in each haul was measured. Three seine hauls were made - one in the west arm, one in the center of the lagoon, and one in the north arm. Figure 2 shows the location of the fish collection stations.

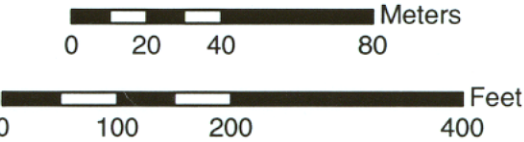
On July 6, 2004, during a -0.6 foot Mean Lower Low Water (MLLW) low tide, Todd Chapman surveyed for clams along the shores of Colorado Lagoon. He inspected the shoreline along the eastern and northern shores of the lagoon (where information indicated digging for clams occurs most frequently). In places where there was visual evidence of clams, he dug up sediments with a shovel and sieved sediments through a 2 millimeter screen. All clams collected were fixed in a formalin solution and identified by Tom Gerlinger in the laboratory.

Figure 2
Vegetation Communities
at Colorado Lagoon

LEGEND

- Core
- Eel Grass
- Seine
- Developed
- Ice Plant
- Open Water
- Ornamental Landscaping
- Pickle Weed/Salt Grass
- Sand

1 centimeter equals 20 meters



Source: City of Long Beach - clr24d.sid - Date: 8-99
z:/proj/3266_Colorado/Veg_Map11x17.mxd



2.2 TERRESTRIAL AND WETLANDS VEGETATION

The plant survey was conducted over the Colorado Lagoon project site by Chambers Group botanist Ken McDonald on Thursday, July 1, 2004.

The protocol used during the survey consisted of walking meandering transects throughout all areas of the site. The project site had generally even topography. All areas of the site were visited. Plant communities were mapped on an aerial photograph of the site.

All plant species observed were recorded in field notes. Plants of uncertain identity were collected and subsequently identified from keys, Hickman (1993) and Munz (1974). Plant nomenclature followed that of The Jepson Manual, Higher Plants of California (Hickman 1993).

SECTION 3.0 – HABITAT ASSESSMENT

3.1 MARINE RESOURCES

3.1.1 Overview

Colorado Lagoon has a narrow bank that slopes steeply to a mud bottom with a depth of about 12 feet MLLW. The substrate throughout most of the lagoon is soft bottom. The foot bridge that spans the center of the lagoon as well as the dock northwest of it provide hard surface for the attachment of sessile organisms. Reportedly a small rock outcrop occurs near the tide gates (Allen and Horn 1975), but it was not observed during the July 1 reconnaissance dive.

The water was extremely turbid during the July 1 reconnaissance dive with underwater visibility only about 1 foot. The bottom was heavily covered with various species of algae.

3.1.2 Water Column Characteristics

Table 2 shows water column profiles of depth, temperature, electrical conductivity, salinity, pH and dissolved oxygen taken by Kinnetics Laboratories in three locations in Colorado Lagoon on June 29, 2004.

Table 2
Water Column Profiles taken by Kinnetics Laboratories in Colorado Lagoon

CL-2 Center		Latitude	Longitude				
Total Depth= 12 ft		33.77098	-118.13248	NAD83			
Date	Time	Depth (m)	Temp(Cent)	EC (mmhos/cm)	Salinity(g/kg)	pH	DO (mg/L)
29-Jun-04	1205	1	23.4	49.6	32.4	7.8	6.9
	1206	2	22.9	49.5	32.4	7.7	4.8
	1207	3	22.6	49.5	32.4	7.7	4.8
	1208	3.75	22.5	49.6	32.5	7.7	4.8
CL-1 West Arm		Latitude	Longitude				
Total Depth= 11.8 ft		33.77209	-118.13599	NAD83			
Date	Time	Depth (m)	Temp(Cent)	EC (mmhos/cm)	Salinity(g/kg)	pH	DO (mg/L)
29-Jun-04	1315	1	23.9	49.2	32.2	7.9	7.3
	1319	2	23.7	49.3	32.3	7.8	6.2
	1320	3	23.3	49.5	32.4	7.6	3.2
	1320	4	23.1	49.6	32.5	7.6	2.8
CL-3 North Arm		Latitude	Longitude				
Total Depth= 13 ft		33.77242	-118.13219	NAD83			
Date	Time	Depth (m)	Temp(Cent)	EC (mmhos/cm)	Salinity(g/kg)	pH	DO (mg/L)
29-Jun-04	1409	1	24.4	49.6	32.5	7.9	8.0
	1410	2	24.0	49.6	32.5	7.9	7.4
	1411	3	23.4	49.7	32.5	7.8	5.6
	1416	4	22.7	49.7	32.5	7.8	4.6

Temperature ranged from 22.5 degrees centigrade (C.) on the bottom in the center of the lagoon to 24.4 degrees at the surface in the north arm. Temperature was slightly stratified. Salinity showed little variation with a range between 32.2 parts per thousand (ppt) at the surface in the west arm to 32.5 ppt at the bottom at all stations and throughout the water column in the north arm. Electrical conductivity, as would be expected, also exhibited minimal variability. The pH ranged from 7.6 toward the bottom in the west arm to 7.9 near the surface in the north and west arms. These measurements are all fairly normal for marine systems. Dissolved oxygen ranged from 2.8 parts per million (ppm) at the bottom in the west arm to 8.0 ppm at the surface in the north arm. Oxygen measurements showed stratification in the water column with lowest readings near the bottom. The water quality standard for single measurements of dissolved oxygen is 5 ppm (RWQCB 1994). Therefore, dissolved oxygen levels near the bottom in all arms of Colorado Lagoon on June 29, 2004, were below the standard. However, fish kills have not been reported in Colorado Lagoon.

The Surfrider Foundation has been measuring water column parameters from the bridge in the center of the lagoon several times per year. These data provide a more comprehensive picture of water column characteristics in the lagoon although they do not provide information on conditions in the north and west arms. Table 3 summarizes the Surfrider Foundation data from May 2000 through January 2002.

Water temperature in the center of Colorado Lagoon ranged from 13.5 degrees C. in February of 2001 to 26 degrees C. in July of 2000. Dissolved oxygen ranged from 3.8 ppm in July of 2000 to 10.8 ppm in January of 2002. Surfrider Foundation recorded dissolved oxygen levels below the standard of 5.0 ppm in July, August, and October of 2000 and August of 2001. The low dissolved oxygen in summer and fall may reflect lack of mixing in the lagoon during these months and/or oxygen demand related to seasonal algae blooms. The range in pH was from a low of 7.4 in January of 2001 to a high of 8 in May of 2000 and January of 2002. Salinity ranged from 27 ppt in August of 2001 to 34 ppt in May of 2000.

Surfrider Foundation measures three nutrients, ammonia, nitrate and phosphate. Ammonia was elevated in all of the samples between April 2001 and January 2002. Nitrate was elevated (2.36 milligrams per liter) in October 2001 and phosphate was elevated in July and August of 2001. Phenols were detected in samples taken between April 2001 and September 2001.

In summary, the water quality data indicate that Colorado Lagoon does not experience extreme temperature or salinity levels, but that dissolved oxygen levels are low during the summer. Nutrient levels are elevated at times.

3.1.3 Aquatic Vegetation

During the July 1 reconnaissance dive, a heavy cover of benthic algae was observed over the bottom. In the northeastern part of the lagoon the dominant algae were primarily *Enteromorpha intestinalis* and *Ulva lobata*. In the western part of the lagoon, a species of red algae, *Gracilaria* sp., was the dominant bottom vegetation.

Eelgrass (*Zostera marina*) is a flowering plant that occurs in harbors and estuaries. Eelgrass meadows are recognized as a particularly valuable type of marine habitat that enhances the physical and biological environment of coastal bays (Phillips 1990). Eelgrass beds occur at Marine Stadium (Ultrasystems 2001). A few scattered eelgrass plants were observed in Colorado Lagoon during the July 1 reconnaissance dive. Figure 2 shows the locations where eelgrass was seen. Eelgrass was observed at a water depth of about -6 feet MLLW.

3.1.4 Invertebrates

The most abundant epifaunal invertebrate observed on the bottom during the July 1 reconnaissance dive was the gelatinous colonial bryozoan *Zoobotryon verticillatum*. This species tends to be associated with warm water temperatures (Reish 1972). The solitary tunicate *Styela plicata* also was common on the bottom of the lagoon and on the pier pilings. Other invertebrates observed during the survey included the

Table 3
Water Quality Measurements by the Surfrider Foundation in the Center of Colorado Lagoon

Date	Weather *	Air Temperature (°C)	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Ph	Salinity (ppt)	Ammonia (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)	Phenol (mg/L)
Clean Seawater Standards **				>4	7.5-8.5	33-36	<0.1	<1.1	<0.2	ND
1/26/2002	Dry	19	14	10.8	8	32	0.72	ND	0.08	ND
10/28/2001	Dry	24	19	9.2	7.9	31	0.1	2.36	0.13	ND
9/23/2001	Dry	22	22	8.2	7.8	30	0.3	0.03	0.11	0.08
8/25/2001	Dry	29	24	4.4	7.8	27	0.49	0.11	0.63	0.28
7/29/2001	Dry	27	23	6.8	7.7	31	0.29	0.02	0.23	0.09
6/23/2001	Dry	29	24	8.4	7.8	30	0.3	0.06	0.13	0.06
4/29/2001	Dry	23	18	10	7.9	32	0.19	0.06	0.12	0.06
2/24/2001	Wet	12	13.5	5.6	7.5	28	ND	ND	ND	ND
1/28/2001	Dry	16.5	16	8.6	7.4	32	ND	ND	ND	ND
10/29/2000	Wet	20	20	4.2	7.6	30	ND	NT	ND	NT
9/24/2000	Dry	26	23	5.2	7.8	29	ND	ND	ND	NT
8/27/2000	Dry	25	20	4.6	7.8	29	ND	ND	ND	ND
7/29/2000	Dry	25	26	3.8	7.6	30	ND	ND	ND	ND
6/3/2000	Dry	23	17	6.8	7.7	NT	ND	ND	0.2	ND
5/14/2000	Dry	25	21	7.3	8	34	ND	ND	ND	ND

* Wet=rain within 48hours, otherwise, dry weather

** Information from Southern California Marine Institute

ND=Not Detectable

NT=Not Tested

introduced mussel *Musculista senhousi* and the bubble snail *Bulla gouldiana*. Bay mussels (*Mytilus galloprovincialis*) grow on the piling and floats. The California horn snail *Cerithidea californica* is very abundant along the intertidal edges of the lagoon. Other large invertebrates reported in Colorado Lagoon but not observed during the reconnaissance survey included octopus, fiddler crabs (*Uca crenulata*), moon jellies (*Aurelia Aurelia*), and mud crabs (*Hemigrapsus oregonensis*). Although the poor underwater visibility and algal mats made it difficult to observe the bottom during the underwater survey, typical estuarine invertebrates such as nemanax (*Cheilodunura inermis*) and sea hares (*Aplysia californica*) were not observed and may be lacking or in low abundance in Colorado Lagoon.

Four species of clam were collected along the shores of Colorado Lagoon during the July 6 clam survey. The clam species collected included smooth chione (*Chione flutifraga*), common littleneck (*Protothaca staminea*), California jackknife clam (*Tagelus californianus*), and Phillipine cockle (*Venerupis philipinarum*).

In the past, Colorado Lagoon was notable for having a large population of the Atlantic quahog or cherrystone clam (*Mercentaria mercenaria*) (Crane et al. 1975). The Colorado Lagoon population of this east coast clam species was thought to be unique to the west coast. There is no record of the introduction of the Atlantic quahog to southern California. However, in the early 1950s a local delicatessen owner illegally introduced one half bushel of cherrystone clams to a restricted area of Alamitos Bay. That original introduction was destroyed in 1954 but the quahogs in Colorado Lagoon may have originated from the illegal Alamitos Bay colony. Population densities of the Atlantic quahog in Colorado Lagoon in the early 1970s were as much as 556 clams per square meter. These large numbers of introduced clams appeared to be out competing native bivalve species by out competing other species for food and by being better able to survive environmental stress (Crane et al 1975). No Atlantic quahogs were collected in the July 6, 2004, survey nor were any identified in the July 1 core samples. Therefore, this species has either been eliminated from Colorado Lagoon or greatly reduced in abundance.

Appendix A lists all of the invertebrates collected in each of the 3 replicate cores at each station. A total of 35 taxa of invertebrates was collected in the nine core samples in Colorado Lagoon. Table 4 summarizes the characteristics of the infauna community at each station.

Table 4
Characteristics of Infauna Community in Colorado Lagoon

Station	Density(#/m2)	Number of Taxa	H' Diversity	Animal Type	Top 3 Taxa
West	2930.2	4	0.76	Snail Isopod Amphipod Worm	<i>Assiminea californica</i> 66.7% <i>Paracereis sculpta</i> 30.4% <i>Monocorophium</i> sp. 1.5% <i>Cirriformia</i> sp. 1.5%
Center	3822	26	2.52	Anemone Amphipod Amphipod Worm	Cnidaria 22.7% <i>Grandidierella japonica</i> 22.0 % <i>Monocorophium</i> sp. 8.7% <i>Streblospio benedicti</i> 8.7%
Northeast	2089.4	18	2.55	Snail Snail Worm	<i>Assiminea californica</i> 20.7% <i>Acteocina inculta</i> 12.2% <i>Streblospio benedicti</i> 9.8%

The number of organisms per square meter ranged from 2089.4 in the northeast arm of the lagoon to 3822 in the center. Therefore, there was little difference between stations in the density of infaunal organisms. The number of taxa collected in the 3 core samples at each station ranged from 4 in the west arm to 26 in the center of the lagoon. The Shannon-Wiener Diversity Index (H') ranged from 0.76 in the west arm to 2.55 in the northeast arm. This diversity index takes into account both the total number of species and the relative percent abundance of those species. Thus, a community is defined as being highly diverse if it has many species with relatively uniform representation. As the number of species

decreases or the fraction of the total population contributed by any one species increases, the diversity index declines. The Shannon-Wiener Diversity Index for the station in the west arm was extremely low because only 4 taxa were collected there and 2 taxa, *Assiminea californica* and *Paracereis sculpta*, accounted for approximately 97 percent of the organisms in those samples. The center and northeast stations, however, with Diversity Indices of 2.52 and 2.55 respectively, had comparatively high diversity for estuarine communities. In comparison, Shannon-Wiener Diversity Indices for core samples taken in the Ballona Wetlands in 1995 ranged from 0.3 to 1.5 (Chambers Group, Inc. 1996). The invertebrate community in the center and northeast arm of the lagoon was characterized by a high number of taxa and even distribution.

The most abundant species in the west and northeast arms was the small snail *Assiminea californica*. This species, which is often associated with vegetation or plant debris, is a common species in southern California salt marshes (Ricketts et al 1985). The most abundant taxa in the center of the lagoon were unidentified cnidarians (sea anemones) and the non-native, tube building amphipod *Grandidierella japonica*.

In summary Colorado Lagoon supports a relatively diverse benthic invertebrate community in the central and northeast portions of the lagoon. The benthic invertebrate community is impoverished in the western arm. The lack of invertebrate diversity in the western arm may be related to toxicity in the sediments or to the relatively low dissolved oxygen levels in this part of the lagoon.

3.1.5 Fishes

Appendix B lists all of the lengths of all of the fishes that were caught in each of the July 1, 2004, beach seines. Appendix B also contains size frequency distributions of each of the species caught in substantial numbers. Table 5 summarizes the number of fishes of each species caught at each station.

Table 5
Fishes Collected in Beach Seines July 1, 2004

Common Name	Scientific Name	Fish Totals			Totals
		East End	Central	West End	
Topsmelt	<i>Atherinops affinis</i>	2,172	4,531	11,997	18,700
Arrow Goby	<i>Clevelandia ios</i>	30	26	0	56
California Killifish	<i>Fundulus parvipinnis</i>	2	12	34	48
Slough Anchovy	<i>Anchoa delicatissima</i>	22	0	0	22
Round Stingray	<i>Urolophus halleri</i>	0	1	19	20
Shadow Goby	<i>Quietula y-cauda</i>	12	3	2	17
Yellowfin Goby	<i>Acanthogobius flavimanus</i>	2	8	4	14
Bay Pipefish	<i>Sygnathus leptorhynchus</i>	1	11	0	12
Longjaw Mudsucker	<i>Gillichthys mirabilis</i>	3	0	2	5
Shiner Perch	<i>Cymatogaster aggregata</i>	0	3	1	4
Cheekspot Goby	<i>Ilypnus gilberti</i>	0	0	2	2
Northern Anchovy	<i>Engraulis mordax</i>	2	0	0	2
California Needlefish	<i>Strongylura exilis</i>	0	1	0	1
Number of Species		9	9	8	13
Totals		2,246	4,596	12,061	18,903

A total of 13 species of fish were caught in the three seine hauls. All are typical estuarine/bay species. The California needlefish is found in Southern California bays but it is relatively uncommon. An additional fish species, staghorn sculpin (*Leptocottus armatus*) was observed but not collected.

Approximately the same number of fish species was caught at each station. A total of 9 species were caught in the central and eastern portions of the lagoon and 8 species were caught in the west end.

The most abundant fish species collected at each of the stations was topsmelt (*Atherinops affinis*). Topsmelt are a schooling, surface-dwelling fish that typically is very abundant in southern California estuaries (Love 1996). The high numbers of topsmelt in Colorado Lagoon provide a foodbase for terns, cormorants and other fish-eating birds.

The second most abundant fish species collected was arrow goby (*Clevelandia ios*). However, no arrow gobies were collected in the trawl at the west end of the lagoon. Arrow gobies live on the mud, often in the burrows of ghost shrimps or innkeeper worms (Emmett et al 1991). Their absence in the west end may be related to sediment toxicity or low dissolved oxygen levels near the bottom. However, trawls in the west arm did collect three other species of gobies, shadow goby (*Quietula y-cauda*), longjaw mudsucker (*Gillichthys mirabilis*), and the non-native yellowfin goby (*Acanthogobius flavimanus*). These other species of gobies also live in borrows (Moyle 2002).

The third most abundant fish species was California killifish (*Fundulus parvipinnis*). Killifish were most abundant in the west arm. California killifish are a common estuarine fish. This species is especially tolerant of a wide range of environmental conditions including polluted and anoxic sediments (Moyle 2002). They may be abundant in the west arm because of their ability to tolerate low oxygen levels and elevated pollutants.

A large number of round stingrays (*Urolophus halleri*) were collected at the station in the west arm. All of the individuals caught were females and many were gravid. Therefore, Colorado Lagoon appears to be a spawning area for this species. It is not known why they congregate in the western end of the lagoon.

All of the species caught in substantial numbers in the beach seines had a relatively wide size distribution (Appendix B). The presence of individuals of different sizes indicates that the fish populations in Colorado Lagoon are not dominated by a single year class.

Historical information on fish populations in Colorado Lagoon is available from studies done in the 1970s (Allen 1975, Allen and Horn 1975). Allen and Horn (1975) sampled fishes by beach seine in Colorado Lagoon every month from January to December 1973. Their sampling methodology (100 foot beach seine deployed from a skiff) was similar to the methodology used by Chambers Group in 2004. Allen and Horn also had one station in the west arm, one station in the center of the lagoon, and one station in the northeast arm. In addition, Allen (1975) made observations and collections of Colorado Lagoon fishes in 1971. Table 6 lists the fish species observed by Allen in 1971 and the number of each species collected in each month in 1973. A total of 23 species of fishes were collected throughout the year in 1973. An additional 6 fish species were observed in 1971 that were not recorded in 1973.

In their publication, Allen and Horn (1975) lumped the collections from all three stations into one table and did not present any information on differences between stations. Allen and Horn collected the highest number of fish species (15) on June 23, 1973. The greatest number of individuals (106,641) was on October 1, 1973. The seine hauls on this date collected very high numbers of northern anchovy (*Engraulis mordax*).

Northern anchovy was the most abundant species collected in 1973, but northern anchovy were abundant only in July, August, October, and, to a lesser extent, June. Topsmelt were the second most abundant fish in the 1973 collections. Topsmelt occurred in relatively high numbers in all months. Slough anchovy (*Anchoa delicatissima*) were the third most abundant fish species, but like northern anchovy, their numbers appeared to be seasonal. High numbers of slough anchovy were collected in June, July, and August. Shiner surfperch (*Cymatogaster aggregata*) were the fourth most abundant species, with highest abundance in the spring and summer. These four species together comprised 99 percent of the fishes collected in the 1973 study. Northern anchovy was considered to be a seasonal species.

Table 6
Monthly Totals (by collection date) of Fish Collected by Allen & Horn in Colorado Lagoon, 1971 & 1973

Species	1971	Jan 5	Feb 17	Mar 2	Apr 21	May 19	Jun 23	Jul 28	Aug 24	(Oct 1)*	Oct 28	Nov 27	Dec 31	Totals
Northern Anchovy (<i>Engraulis mordax</i>)		2				5	324	6,432	23,750	106,250		1	6	136,770
Topsmelt (<i>Atherinops affinis</i>)	X	340	358	555	696	400	180	230	285	188	1,600	414	1,102	6,348
Slough Anchovy (<i>Anchoa delicatissima</i>)	X				35	3	2,024	356	2,250	18	44		27	4,757
Shiner Surfperch (<i>Cymatogaster aggregata</i>)	X	2	2	5	630	923	616	157	455	97	193	2	9	3,091
California Killifish (<i>Fundulus parvipinnis</i>)	X	84	187	10	60	21	4	25	21	41	17	1		471
California Grunion (<i>Leuresthes tenuis</i>)		15					8	276	30	11	6			346
Staghorn Sculpin (<i>Leptocottus armatus</i>)	X	1	1	11	64	56	20	11	52	7	1			224
Deepbody Anchovy (<i>Anchoa compressa</i>)	X						25			26				51
Striped Mullet (<i>Mugil cephalus</i>)	X		41											41
Pile Surfperch (<i>Damalichthys vacca</i>)	X		5		9	9		1					1	25
Shadow Goby (<i>Quietula y-cauda</i>)				3		1	1		3	2				10
Threadfin Shad (<i>Dorosoma petenense</i>)									8					8
Black Surfperch (<i>Embiotoca jacksonii</i>)	X		1			4								5
Spotted Sand Bass (<i>Paralabrax maculofaciatus</i>)	X					1	1	2				1		5
Diamond Turbot (<i>Hypopsetta guttulata</i>)	X			1			3							4

Table 6 (continued)
Monthly Totals (by collection date) of Fish Collected by Allen & Horn in Colorado Lagoon, 1971 & 1973

Species	1971	Jan 5	Feb 17	Mar 2	Apr 21	May 19	Jun 23	Jul 28	Aug 24	(Oct 1)*	Oct 28	Nov 27	Dec 31	Totals
Bat Ray (<i>Myliobatis californica</i>)									3					3
Round Stingray (<i>Urolophus halleri</i>)	X					1		1						2
White Surfperch (<i>Phanerodon furcatus</i>)				1			1							2
Arrow Goby (<i>Clevelandia ios</i>)	X					1				1				2
White Croaker (<i>Genyonemus lineatus</i>)	X						1							1
California Corbina (<i>Menticirrhus undulatus</i>)							1							1
Spotfin Croaker (<i>Roncador stearnsii</i>)							1							1
Queenfish (<i>Seriophus politus</i>)								1						1
Bonefish (<i>Albula vulpes</i>)	X													
Kelp Bass (<i>Paralabrax clathratus</i>)	X													
Barred Sand Bass (<i>Paralabrax nebulifer</i>)	X													
Sargo (<i>Anisotremus davidsonii</i>)	X													
Salema (<i>Xenistius californiensis</i>)	X													
Dwarf Surfperch (<i>Micrometrus minimus</i>)	X													
Total Individuals	NA	444	595	585	1,495	1,425	3,210	7,492	26,857	106,641	1,861	419	1,145	152,169
Total Species	20	6	7	6	7	12	15	11	10	10	6	5	5	23

* Counted as September sample

Based on fish species captured in all or most of the 12 months of sampling in 1973, Allen and Horn (1975) suggested that five species, topsmelt, shiner surfperch, California killifish, slough anchovy and staghorn sculpin, were resident in Colorado Lagoon.

A comparison of the 1973 study with the July 2004 survey suggests that, in general, the fish community in Colorado Lagoon in 2004 is similar to that in 1973. Some striking differences were noted, however. Only 2 northern anchovy were collected in 2004 compared to thousands in 1973, but this species appears to be sporadic in occurrence. Slough anchovy and shiner surfperch also were less abundant in the 2004 survey compared to 1973. The decrease in slough anchovy like that of northern anchovy may indicate that slough anchovy enter the lagoon sporadically. Shiner surfperch probably have decreased in abundance in Colorado Lagoon since 1973. Many species of surfperch have declined in abundance since the warm water El Niño years. Conversely, only 2 arrow gobies and 2 round stingrays were collected in all of 1973 compared to 56 and 20 in the July 2004, survey. It would appear that the stingray spawning observed in 2004 did not occur in 1973. Arrow gobies also appear to have increased in abundance since 1973.

None of the three fish surveys collected California halibut (*Paralichthys californicus*). However, fishermen reportedly catch this species in Colorado Lagoon. Juvenile halibut use the calm waters of bays and estuaries as nursery areas. Allen (1988) found that large numbers of young of the year halibut occur in the protected waters of Alamitos Bay. Apparently, these young halibut do not move into Colorado Lagoon in substantial numbers. The reason juvenile halibut do not use Colorado Lagoon as a nursery is unknown. Perhaps the long pipe from Marine Stadium discourages their movement or perhaps they avoid the lagoon because of the low oxygen levels near the bottom in summer.

3.1.6 Water-associated Birds

A substantial number of waterbirds use Colorado Lagoon for resting and foraging. Bird use of the lagoon peaks in the winter months with as many as 600 species visiting the lagoon in February (Bentley-Smith 2003, Sonnenberg, Personal Communication). Fewer birds frequent the lagoon in the summer months.

Richard Sonnenberg has been monitoring waterbird populations in Colorado Lagoon for approximately 5 years. Table 7 lists waterbirds observed by Sonnenberg in Colorado Lagoon between September 1, 2002, and June 4, 2004, with the waterbird count on June 4, 2004. Between September 2002 and June 2004, 37 waterbird species were identified in Colorado Lagoon. The avifauna of the lagoon includes feral individuals of domestic ducks and geese, grebes, several species of ducks, double-crested cormorants (*Phalacrocorax auritus*), American coots (*Fulica Americana*), gulls, terns, herons and egrets, and at least 14 species of shorebird. Two state and federal endangered bird species, California least tern (*Sterna antillarum browni*) and California brown pelican (*Pelecanus occidentalis californicus*), were recorded in the lagoon. The osprey (*Pandion heliaetus*), a fish-eating hawk, has been observed in Colorado Lagoon. In June 2004, the avifauna in the lagoon was dominated by mallards, western gulls, and ring-billed gulls.

3.2 TERRESTRIAL HABITAT

3.2.1 Overview

Colorado Lagoon is located in suburban Long Beach. The lagoon is surrounded by a landscaped park and is located just south of a golf course. Some natural salt marsh habitat occurs around the edges of the lagoon.

3.2.2 Vegetation

Figure 2 shows plant communities surrounding Colorado Lagoon. Table 8 lists plant species observed during the July 1, reconnaissance survey.

Table 7
Waterbirds Counted by Richard Sonnenberg in Colorado Lagoon
Friday, June 4, 2004

Species	Number
Pied-billed grebe	0
Eared grebe	0
Double-crested cormorant	0
Feral goose	0
Feral ducks	6
Mallard (incl. mixed & chicks)	33
Gadwall	0
American wigeon	0
Cinnamon teal	0
Northern shoveler	0
Redhead	0
Common goldeneye	0
Greater scaup	0
Lesser scaup	0
Bufflehead	0
Ruddy duck	0
Red-breasted merganser	1
Osprey	0
American coot	0
Brown pelican	0
Heermann's gull	0
Herring Gull	0
Western gull	22
Glaucous-winged gull	0
California gull	27
Ring-billed gull	1
Forster's tern	7
Least tern	0
Great blue heron	1
Black-crowned night heron	0
Green heron	2
Great egret	0
Snowy egret	1
Black-bellied plover	0
Semipalmated plover	0
Killdeer	0
Whimbrel	0
Marbled godwit	2
Black-necked stilt	0
Willet	0
Long-billed dowitcher	0
Dunlin	0
Spotted sandpiper	0
Least sandpiper	0
Western sandpiper	0
Belted kingfisher	0
Number of species this season:(as of 9/1):	37
Number of species this week:	11
Number of birds this week:	103

**Table 8
Colorado Lagoon Plant List**

Scientific Name	Common Name
GYMNOSPERMS	
PINACEAE <i>Pinus</i> sp.	PINE FAMILY Pine
PODOCARPACEAE <i>Podocarpus macrophyllus</i> *	PODOCARP FAMILY plum pine
ANGIOSPERMS (DICOTYLEDONS)	
AIZOACEAE <i>Carpobrotus</i> sp.* <i>Mesembryanthemum crystallinum</i> *	FIG-MARIGOLD FAMILY Iceplant crystalline iceplant
ANACARDIACEAE <i>Schinus molle</i> * <i>Schinus terebinthifolius</i> *	SUMAC OR CASHEW FAMILY Peruvian pepper tree Brazilian pepper tree
APIACEAE <i>Ciclospermum leptophyllum</i> *	CARROT FAMILY marsh-parsley
APOCYNACEAE <i>Nerium oleander</i> *	DOGBANE FAMILY Oleander
ARALIACEAE <i>Hedera helix</i> *	GINSENG FAMILY English ivy
ASTERACEAE <i>Ambrosia psilostachya</i> <i>Anthemis cotula</i> * <i>Bellis perennis</i> * <i>Conyza bonariensis</i> * <i>Conyza Canadensis</i> <i>Gnaphalium</i> sp. <i>Jaumea carnosa</i> <i>Picris echioides</i> * <i>Psilocarphus tenellus</i> <i>Senecio vulgaris</i> * <i>Sonchus asper</i> * <i>Sonchus oleraceus</i> * <i>Taraxacum officinale</i> *	SUNFLOWER FAMILY western ragweed Mayweed English daisy flax-leaved horseweed Horseweed cudweed fleshy Jaumea bristly ox-tongue slender woolly-heads common groundsel prickly sow thistle common sow thistle common dandelion
BETULACEAE <i>Alnus rhombifolia</i>	BIRCH FAMILY white alder
BIGNONIACEAE <i>Jacaranda mimosifolia</i> *	BIGNONIA FAMILY Jacaranda
BRASSICACEAE <i>Brassica rapa</i> * <i>Hirshfeldia incana</i> * <i>Sisymbrium altissimum</i> *	MUSTARD FAMILY field mustard short-podded mustard tumble mustard
CARYOPHYLLACEAE <i>Spergularia</i> sp.	PINK FAMILY Sandspurrey

Table 8 (continued)
Colorado Lagoon Plant List

Scientific Name	Common Name
CHENOPODIACEAE	GOOSEFOOT FAMILY
<i>Atriplex semibaccata</i> *	Australian saltbush
<i>Atriplex triangularis</i>	Spearscale
<i>Bassia hyssopifolia</i> *	five-hooked bassia
<i>Beta vulgaris</i> *	Beet
<i>Chenopodium album</i> *	lamb's quarters
<i>Salicornia virginica</i>	common pickleweed
<i>Salicornia subterminalis</i>	Parish's pickleweed
<i>Salsola tragus</i> *	Russian thistle
<i>Suaeda calceoliformis</i>	horned sea-blite
CONVOLVULACEAE	MORNING-GLORY FAMILY
<i>Cressa truxillensis</i>	alkali weed
CRASSULACEAE	STONECROP FAMILY
<i>Crassula ovata</i> *	jade plant
EUPHORBIACEAE	SPURGE FAMILY
<i>Chamaesyce maculata</i> *	spotted spurge
<i>Chamaesyce</i> sp.	spurge
FABACEAE	LEGUME FAMILY
<i>Erythrina</i> sp.*	coral tree
<i>Lotus corniculatus</i> *	birdfoot trefoil
<i>Medicago lupulina</i> *	black medick
<i>Medicago polymorpha</i> *	bur clover
<i>Melilotus indica</i> *	Sourclover
<i>Trifolium repens</i> *	white clover
<i>Trifolium willdenovii</i>	tomcat clover
FRANKENIACEAE	FRANKENIA FAMILY
<i>Frankenia salina</i>	alkali heath
MAGNOLIACEAE	MAGNOLIA FAMILY
<i>Magnolia</i> sp.	magnolia
MALVACEAE	MALLOW FAMILY
<i>Malva parviflora</i> *	Cheeseweed
<i>Malvella leprosa</i>	alkali-mallow
MORACEAE	MULBERRY FAMILY
<i>Ficus macrophylla</i> *	bay fig
MYOPORACEAE	MYOPORUM FAMILY
<i>Myoporum laetum</i> *	Myoporum
MYRTACEAE	MYRTLE FAMILY
<i>Callistemon</i> sp.*	bottlebrush tree
<i>Eucalyptus camaldulensis</i> *	red gum
<i>Eucalyptus globulus</i> *	blue gum
OLEACEAE	OLIVE FAMILY
<i>Fraxinus</i> sp.	Ash

Table 8 (continued)
Colorado Lagoon Plant List

Scientific Name	Common Name
ONAGRACEAE <i>Clarkia botatae</i>	EVENING PRIMROSE FAMILY punchbowl godetia
OXALIDACEAE <i>Oxalis corniculata</i> *	OXALIS FAMILY creeping wood-sorrel
PLANTAGINACEAE <i>Plantago major</i> * <i>Plantago ovata</i>	PLANTAIN FAMILY common plantain woolly plantain
PLUMBAGINACEAE <i>Limonium californicum</i>	LEADWORT FAMILY western marsh rosemary
POLYGONACEAE <i>Rumex crispus</i> *	BUCKWHEAT FAMILY curly dock
PORTULACACEAE <i>Portulaca oleracea</i> *	PURSLANE FAMILY common purslane
PRIMULACEAE <i>Anagallis arvensis</i> *	PRIMROSE FAMILY scarlet pimpernel
ROSACEAE <i>Escallonia</i> sp.*	ROSE FAMILY Escallonia
SAPINOACEAE <i>Cupaniopsis anacardioides</i> *	SOAPBERRY FAMILY Carrotwood
SOLANACEAE <i>Solanum</i> sp.	NIGHTSHADE FAMILY Nightshade
ULMACEAE <i>Ulmus parvifolia</i> *	ELM FAMILY Chinese elm
ANGIOSPERMS (MONOCOTYLEDONS)	
ARECACEAE <i>Arecastum romanzoffianum</i> * <i>Phoenix canariensis</i> * <i>Washingtonia filifera</i>	PALM FAMILY queen palm Canary Island date palm California fan palm
CYPERACEAE <i>Cyperus</i> sp. <i>Eleocharis</i> sp.	SEDGE FAMILY Cyperus spike-rush
JUNCACEAE <i>Juncus bufonius</i>	RUSH FAMILY toad rush
LILIACEAE <i>Asparagus plumosa</i> *	LILY FAMILY asparagus fern
POACEAE <i>Bromus carinatus</i> <i>Bromus diandrus</i> * <i>Cynodon dactylon</i> * <i>Digitaria sanguinalis</i> * <i>Distichlis spicata</i> <i>Lolium multiflorum</i> * <i>Lolium perenne</i> * <i>Paspalum dilatatum</i> * <i>Poa annua</i> *	GRASS FAMILY California brome ripgut grass Bermuda grass hairy crabgrass Saltgrass Italian ryegrass perennial ryegrass dallis grass annual bluegrass

Three plant communities, as well as bare sand and open water, were identified and mapped during the survey. The plant communities in the project area included coastal brackish marsh, iceplant series, and ornamental landscaping. The habitats were visited to identify dominant species and to classify each vegetation type according to appropriate nomenclature (Hickman 1993) and other systems, as applicable (e.g., Holland 1986, Sawyer and Keeler-Wolf 1995, Gray and Bramlet 1992). The plant communities surrounding Colorado Lagoon are described below.

Coastal Brackish Marsh

This community is usually dominated by perennial, emergent, herbaceous monocots, with characteristics similar to salt marshes. Coastal Brackish Marsh communities are found at the interior edges of coastal bays, estuaries, and lagoons, where they occasionally intergrade with freshwater marshes and coastal salt marshes (Holland 1986). The most common species observed on the Colorado Lagoon project site included common pickleweed (*Salicornia virginica*), salt grass (*Distichlis spicata*), sand spurrey (*Spergularia* sp.), fleshy jaumea (*Jaumea carnosa*), and alkali weed (*Cressa truxillensis*). Coastal Brackish Marsh occurred as a thin band along the edge on the western and eastern arms of Colorado Lagoon. There was one small patch of salt grass with a small amount of pickleweed near the tidegates. Pickleweed along the steep northwestern shore of the lagoon was sparse and appeared to be stressed. The pickleweed on the eastern shore of the north arm was growing more vigorously, but was being out-competed by iceplant. Salt marsh habitat along the western arm was patchy. Pickleweed adjacent to the golf course lawn along the edge of the western arm of the lagoon appeared to be mowed from regular lawn maintenance.

Iceplant Series

Iceplant is an invasive, non-native species. Iceplant species are generally the sole or dominant species in the ground cover for this community. This community is often found on bluffs, disturbed land, and sand dunes adjacent to the coastline (Sawyer and Keeler-Wolf 1995). The Iceplant Series community was found along the eastern edge of Colorado Lagoon. The community on the Colorado Lagoon site is dominated by *Carpobrotus*, with occasional intergradations with the coastal brackish marsh species and non-native species, including common pickleweed, western marsh rosemary (*Limonium californicum*), and African daisy (*Arctotis* sp.).

Ornamental Landscaping

Ornamental landscaping consists of introduced trees, shrubs, and turf grass. This type of vegetation occurs in greenbelts, parks, and horticultural plantings throughout urban areas (Gray and Bramlet 1992). Turf grass composed the dominant herbaceous layer throughout the Colorado Lagoon park areas. An open canopy of ornamental and native planted trees were scattered throughout the park, including Eucalyptus (*Eucalyptus* sp.), coral tree (*Erythrina* sp.), Canary palm (*Phoenix canariensis*), jacaranda (*Jacaranda mimosifolia*), ash (*Fraxinus* sp.), and myoporum (*Myoporum latum*). The lagoon is surrounded by ornamental landscaping on the northern portions and the southern and southwestern portions of the project site.

3.2.3 Wildlife

Colorado Lagoon is located in the middle of suburban Long Beach. Therefore, terrestrial wildlife associated with the lagoon is dominated by urban-adapted species. Land bird species observed by Chambers Group during visits to Colorado Lagoon included black phoebe (*Sayornis nigricans*), American crow (*Corvus brachyrhynchos*), cliff swallow (*Hirundo pyrrhonota*), and rock dove (*Columba livia*). Other urban adapted species such as house finch (*Carpodacus mexicanus*), Annas hummingbird (*Calypte anna*), European starling (*Sturnus vulgaris*), yellow-rumped warbler (*Dendroica coronata*), mourning dove (*Zenaidamacroua*), and house sparrow (*Passer domesticus*) also would be expected.

A number of urban-adapted mammal species have been observed around Colorado Lagoon (K. Garvey, Moffatt & Nichol, Personal Communication, July, 2004). These include striped skunk (*Mephitis mephitis*), opossum (*Didelphis marsupialis*), ground squirrels (*Citellus beecheyi*), raccoon (*Procyon lotor*), red fox (*Vulpes fulva*) and a coyote (*Canis latrans*).

SECTION 4.0 – HABITAT ENHANCEMENT OPPORTUNITIES

Based on this habitat assessment a preliminary list of habitat assessment opportunities was identified. This preliminary list does not consider potential physical constraints or conflicting uses.

4.1 AQUATIC HABITAT

4.1.1 Water Quality/Tidal Range

Colorado Lagoon supports an abundance of fishes and a diverse infaunal invertebrate community except in the western arm. The impoverished invertebrate community in the western arm most likely is related to poor water and/or sediment quality. Therefore, improvement of water and sediment quality in Colorado Lagoon would enhance the benthic invertebrate community in the western arm. In addition, arrow gobies are scarce in the western arm. Improved water quality might enhance the environment for arrow gobies.

Juvenile halibut do not use Colorado Lagoon as a nursery area. The reason for the lack of juvenile halibut in the lagoon is unknown. Improvement in water quality might improve the ability of the lagoon to support juvenile halibut. Juvenile halibut also might be inhibited from entering the lagoon by the tidal constriction at the tide gates. Improved tidal flushing might increase the chance that juvenile halibut would enter the lagoon. Increased tidal flushing also would help to improve water quality.

4.1.2 Eelgrass

Eelgrass beds enhance the marine environment of bays and harbors. They provide attachment, food, and shelter for invertebrates and shelter for fishes. They also help to stabilize sediments. Presently, eelgrass in Colorado Lagoon is too sparse to provide much habitat benefit. Eelgrass beds can be established by transplanting eelgrass from an area, such as Marine Stadium, where substantial beds occur. However, the fact that eelgrass does occur in Colorado Lagoon but it has not proliferated suggests that water quality in the lagoon may be inhibiting establishment of beds. Eelgrass is light sensitive and the excessive turbidity in Colorado Lagoon, especially during the summer growing season, may be preventing it from spreading. Therefore, improved water quality and tidal flushing probably would improve the chances that eelgrass beds could become established in the lagoon.

4.1.3 Intertidal Foraging Habitat for Shorebirds

Shorebirds forage on intertidal mudflats and sand flats. Presently this habitat is limited in Colorado Lagoon. The intertidal area consists of a narrow band around the lagoon and the beaches is the central portion of the lagoon. The beach areas are heavily disturbed by human use. Shorebirds are disturbed by human activity and, particularly, by dogs. If human use could be confined to the southern shore of the central portion of the lagoon, there may be an opportunity to provide intertidal habitat for shorebird foraging on the north shore. It might be possible to increase the tidal range either by grading the beach or increasing tidal flushing or both. If the intertidal area were increased, there would be more foraging area for shorebirds. In addition, shorebird use of this area would be enhanced if human use were discouraged. Perhaps the beach could be fenced and viewing platforms provided with information on the types of shorebirds that occur and the importance of intertidal foraging habitat.

4.2 TERRESTRIAL AND WETLANDS HABITAT

4.2.1 Mid and High Marsh Habitat

Tidal marsh habitat dominated by pickleweed occurs along the shores of the west and north arms of Colorado Lagoon. However, this habitat is of low quality because of a number of disturbances including excessive inundation, invasion by non-natives, mowing, and trampling by people.

Pickleweed and saltgrass are limited to a narrow band surrounding the lagoon. It might be possible to increase both the quantity and quality of this habitat by expanding the width of this band. Along the west shore of the northern arm, the bank is steep and pickleweed appears to be in poor shape because it is inundated too frequently. If the steep bank could be graded to a longer, gentler slope the width of the salt marsh band could be increased and habitat could be provided for pickleweed above the mean higher high water line where it is inundated less frequently and grows better. Along the eastern shore of the north arm, salt marsh is being invaded by iceplant. Removal of iceplant would enhance the saltmarsh habitat in this area. In the western arm, salt marsh is being mowed by the gardeners responsible for upkeep of the turf in the adjacent golf course. Marsh vegetation would be enhanced in these areas by fencing it to restrict golf course gardeners from interfering with it.

Marsh habitat could be increased in diversity by introducing native species that currently are not present at Colorado Lagoon. The habitat also should be protected from human disturbance by signs and possibly fencing and walkways. Signs depicting salt marsh plants and explaining the salt marsh ecosystem would provide public education and would help people to understand why it is important not to disturb this habitat.

4.2.2 Low Tidal Marsh Habitat

Low tidal marsh habitat characterized by cordgrass (*Spartina foliosa*) does not exist at Colorado Lagoon. Cordgrass grows between mean high water and mean higher high water in California estuaries. Cordgrass usually does best in areas that have a full tidal range. It may be possible to establish cordgrass in Colorado Lagoon if the tidal range could be improved. Cordgrass probably would need to be established by planting.

4.2.3 Upland Habitat

Almost all of the upland habitat surrounding Colorado Lagoon consists of landscaping and non-native plants. The introduction of native plants would attract more species of birds and would enhance the ecosystem. Opportunities to establish upland habitat could include replacement of non-native trees with native tree species such as western sycamore (*Platanus racemosa*). Scrub habitat consisting of native shrubs could be planted as a buffer around the upland edge of the lagoon and also between the lagoon park and the golf course.

SECTION 5.0 – CONCLUSIONS

Colorado Lagoon supports valuable estuarine habitat. The lagoon itself supports a diverse community of estuarine fishes and invertebrates and water-associated birds. The abundance of water column fishes is extremely high in the summer, providing a rich food base for piscivorous birds. However, the marine habitat in Colorado Lagoon is degraded by low oxygen levels, low water quality, excessive nutrients, polluted sediments and high sediment toxicity. Conditions appear to be most degraded in the western arm of the lagoon. Some aquatic species including eelgrass and juvenile halibut, typical of healthy estuaries, are sparse in Colorado Lagoon. Improved water quality and tidal flushing would improve the quality of aquatic habitat in the lagoon.

Degraded marsh dominated by pickleweed and salt grass occurs along the edges of the western and northern arms of Colorado Lagoon. This habitat could be enhanced by increasing the width of the intertidal area, removing invasive ice plant, and protecting the habitat from human intrusion.

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6.2 PERSONS CONTACTED

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